

**REMARKS**

This request for reconsideration is filed in response to the Office Action dated December 31, 2007. In view of these remarks, this application should be allowed and the case passed to issue.

Claims 1 and 3 are pending in this application. Claims 1 and 3 are rejected. Claim 2 was previously canceled.

***Claim Rejections Under 35 U.S.C. § 103***

Claims 1 and 3 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over Gyenge et al. (U.S. Pat. No. 7,060,391) in view of Ishikura et al. (U.S. Pat. No. 4,473,623), and further in view of Kobayashi et al. (U.S. Pat. No. 6,558,848). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The following is a comparison between the invention, as claimed, and the cited prior art.

An aspect of this invention, per claim 1, is a valve-regulated lead-acid battery comprising an electrode plate group and an electrolyte impregnated into and retained by the electrode plate group. The electrode plate group comprises positive electrode plates that each include a positive electrode current collector comprising a Sn-containing lead alloy, and a positive electrode active material retained by the positive electrode current collector. The electrode plate group further comprises negative electrode plates each including a negative electrode current collector comprising a lead alloy and a negative electrode active material retained by the negative electrode current collector and separators. The Sn content in the positive electrode current collector is 1.6 to 2.5 % by mass. Pore volume per unit mass of the negative electrode active material is 0.115 to 0.150 cm<sup>3</sup>/g. Part of the electrolyte is a free electrolyte that is free from the electrode plate group and the free electrolyte is in contact with the separators.

Another aspect of the invention, per claim 3, is a valve-regulated lead-acid battery comprising a battery set. The battery set comprises a plurality of unit batteries that are connected in series. The unit batteries each comprising an electrode plate group and an electrolyte impregnated into and retained by the electrode plate group. The electrode plate group comprises positive electrode plates that each include a positive electrode current collector comprising a Sn-containing lead alloy and a positive electrode active material retained by the positive electrode current collector. The electrode plate group further comprises negative electrode plates each including a negative electrode current collector comprising a lead alloy and a negative electrode active material retained by the negative electrode current collector and separators. The Sn content in the positive electrode current collector is 1.6 to 2.5 % by mass. The pore volume per unit mass of the negative electrode active material is 0.115 to 0.150 cm<sup>3</sup>/g. Part of the electrolyte is a free electrolyte that is free from the electrode plate group and the free electrolyte is in contact with the separators.

The Examiner characterized Gyenge et al. as disclosing (col. 6, lines 10 - 15) a lead-acid battery comprising positive electrode plates including positive current collectors (grids) formed of a Pb-Sn alloy, wherein the Sn content of the Pb-Sn alloy is in the range 0.5 to 2.0 % by weight. The Examiner acknowledged that Gyenge et al. (1) do not disclose impregnating the electrodes of the battery with electrolyte, and (2) do not specify the pore volume per unit weight of the negative electrode active material as being in the range of 0.115 to 0.150 cm<sup>3</sup>/gm. In order to remedy deficiency (1) of Gyenge et al., the Examiner alleged that Ishikura et al. teach that "it is well known in the art to impregnate lead acid electrolytes [electrodes] with electrolyte in order to improve discharge storage characteristics." As for deficiency (2), the Examiner opined that "[w]ith respect to the pore volume per unit mass of the negative electrode, it would have been

obvious ... to employ the instant characteristics, since ... discovering the optimum value of a result effective variable involves only routine skill in the art." The Examiner further declared "[i]f it is within the artisan's skill to optimize result effective variables, then the test for optimization is satisfied." The Examiner relied on Kobayashi et al. as allegedly teaching modifying pore volume to improve mechanical strength of the electrode.

The rejections are vigorously traversed. Gyenge et al., Ishikura et al., and Kobayashi et al., whether taken singly or in combination, fail to recognize the problem addressed and solved by the instant invention arising from two competing factors or tendencies present in the subject lead-acid batteries (as described in the "Best Mode" section of the application). Fig. 2 of the present specification clearly establishes the unexpected results and criticality of the claimed ranges. There is no suggestion of the unexpected results in the cited references.

Kobayashi et al. teach that the pore volume should be as large as possible, however, Kobayashi et al. describe the pore volume of the microporous current collector, not the pore volume of the active material. Furthermore, the data in the present specification clearly show that when the pore volume of the negative electrode **active material** above  $0.150 \text{ cm}^3/\text{g}$ , there is a significant decrease in trickle life not at all suggested by the cited prior art. As explained on pages 13-20 of the specification and clearly illustrated in Figs. 1 and 2, and Table 1, the data show the criticality of the claim ranges and the unexpected results (decreased trickle current and increased trickle life) provided by the claimed combination of ranges. The demonstrated unexpected results clearly overcome the Examiner's conclusion of obviousness. The excellent trickle life characteristics of batteries according to the present invention is illustrated in **Fig. 2**, which clearly demonstrate the unexpected improvement in battery groups D, E, and F, in which

Sn content in the positive current collector is 1.6 to 2.5% by mass (see page 14, lines 20-23 of the specification).

The combination of references fail to recognize the problem addressed and solved by the instant invention arising from two competing factors or tendencies present in the subject lead-acid batteries (as described in the "Best Mode" section of the application). Specifically, the instant invention addresses and solves the problem arising from the need to regulate the pore volume of the negative electrode active material in order to provide excellent gas (O<sub>2</sub>) absorbing ability. However, regulation of the pore volume in order to provide excellent gas (O<sub>2</sub>) absorbing ability results in a increase in the trickle charge current, thereby disadvantageously increasing corrosion of the Pb-Sn alloy-based positive electrode current collector (grid).

According to the instant invention, a valve-regulated lead-acid battery having a number of advantageous features and which avoids or obviates the abovementioned competing factors or tendencies is obtained by providing **positive** electrodes with current collectors (grids) made of a Pb-Sn alloy having Sn content in the range 1.1 – 2.5 % by weight **and negative** electrodes with active material having pore volume per unit weight of the negative electrode active material in the range of 0.115 to 0.150 cm<sup>3</sup>/gm. The claimed **combination** of positive and negative electrode features is neither disclosed or remotely suggested by either of the applied references, whether taken singly or in any possible combination, and provides valve-regulated, electrolyte impregnated lead-acid batteries with excellent O<sub>2</sub> gas absorbing ability at the negative electrodes, excellent trickle life characteristics, and reduced corrosion of the positive electrode current collector (grid). In addition, when a plurality of the inventive batteries are connected in series, the charge voltages of the individual batteries are very similar. As a consequence, shortened

trickle charge lifetimes of sets of batteries due to variation in charge voltages is suppressed or avoided.

Furthermore, Kobayashi et al. is concerned with lithium ion and alkaline secondary batteries. There is no suggestion that the problem and solutions discussed in Kobayashi et al. would be relevant to lead-acid batteries. Thus, there is no suggestion to combine Kobayashi et al. with Gyenge et al. and Ishikura et al.

Obviousness can be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge readily available to one of ordinary skill in the art. *In re Kotzab*, 217 F.3d 1365, 1370 55 USPQ2d 1313, 1317 (Fed. Cir. 2000); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992); *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). There is no suggestion in Gyenge et al., Ishikura et al., and Kobayashi et al. to provide a valve-regulated lead-acid battery wherein the Sn content in the positive electrode current collector is 1.6 to 2.5 % by mass and pore volume per unit mass of the negative electrode active material is 0.115 to 0.150 cm<sup>3</sup>/g, as required by claims 1 and 3, nor does common sense dictate the Office Action-asserted combination of Gyenge et al., Ishikura et al., and Kobayashi et al. There is no evidence in the Office Action that there would be any obvious benefit in making the asserted combination of Gyenge et al., Ishikura et al., and Kobayashi et al. *See KSR Int'l Co. v. Teleflex, Inc.*, 500 U.S. \_\_\_\_ (No. 04-1350, April 30, 2007) at 20.

The mere fact that references can be modified does not render the resulting combination obvious unless the desirability of the modification is also suggested. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Gyenge et al., Ishikura et al., and Kobayashi et al. do not

suggest the desirability of modifying a valve-regulated lead-acid battery so that the Sn content in the positive electrode current collector is 1.6 to 2.5 % by mass and pore volume per unit mass of the negative electrode active material is 0.115 to 0.150 cm<sup>3</sup>/g, as required by claims 1 and 3.

The requisite motivation to support the ultimate legal conclusion of obviousness under 35 U.S.C. § 103 is not an abstract concept, but must stem from the applied prior art as a whole and realistically impel one having ordinary skill in the art to modify a specific reference in a specific manner to arrive at a specifically claimed invention. *In re Deuel*, 51 F.3d 1552, 34 USPQ2d 1210 (Fed. Cir. 1995); *In re Newell*, 891 F.2d 899, 13 USPQ2d 1248 (Fed. Cir. 1989).

Accordingly, the Examiner is charged with the initial burden of identifying a source in the applied prior art for the requisite realistic motivation. *Smiths Industries Medical System v. Vital Signs, Inc.*, 183 F.3d 1347, 51 USPQ2d 1415 (Fed. Cir. 1999); *In re Mayne*, 104 F.3d 1339, 41 USPQ2d 1449 (Fed. Cir. 1997). The Examiner has not identified any motivation in Gyenge et al., Ishikura et al., and Kobayashi et al. to modify the battery of Gyenge et al. to provide a valve-regulated lead-acid battery wherein the Sn content in the positive electrode current collector is 1.6 to 2.5 % by mass and pore volume per unit mass of the negative electrode active material is 0.115 to 0.150 cm<sup>3</sup>/g, as required by claims 1 and 3.

The only teaching of the claimed battery is found in Applicants' disclosure. However, the teaching or suggestion to make a claimed combination and the reasonable expectation of success must not be based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). It is apparent that the Examiner's conclusion of obviousness is rooted in impermissible hindsight reasoning.

In view of the above remarks, Applicants submit that this application should be allowed and the case passed to issue. If there are any questions regarding this response or the application

**Application No.: 10/520,894**

in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP



Bernard P. Codd

Registration No. 46,429

600 13<sup>th</sup> Street, N.W.  
Washington, DC 20005-3096  
Phone: 202.756.8000 BPC:MWE  
Facsimile: 202.756.8087  
**Date: March 31, 2008**

**Please recognize our Customer No. 20277  
as our correspondence address.**